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Studies on morphology and taxonomy of some species of the genus *Dictyocaulus* Railliet et Henry 1907

Badania nad morfologią i taksonomią niektórych gatunków rodzaju *Dictyocaulus* Railliet et Henry 1907

The present day opinion on morphology and taxonomy of some species of the genus *Dictyocaulus* Railliet et Henry 1907 are contradictory. In 1907, Railliet et Henry have created this genus to embrace the species *D. filaria* (Rudolphi 1809), *D. viviparus* (Bloch 1782), *D. arnfieldi* (Cobbold 1884), and *D. noerneri* (Railliet et Henry 1907); at the same time Railliet et Henry recognized *D. filaria* as a typical representative of the genus.

During the following years, several authors have described new representatives of the genus *Dictyocaulus*, hitherto unknown to science. So, Chapin has given the description of a new species *D. hadweni* Chapin 1925, from the lungs of the *Bison bison* L. while Skrjabin 1931 has reported of a new species, *D. eckerti* Skrjabin 1931, from the lungs of the *Rangifer tarandus* L. Further new species that were included into the genus *Dictyocaulus* were the following: *D. sibiricus* Orlov 1934, *D. unequalis* Bhalerao 1932, *D. khawi* Hsü 1932, *D. bisonis* Koffman 1942, and *D. cameli* Boyev 1951.

The first revision within the genus *Dictyocaulus* was carried out by Skrjabin in 1934. As a result of this revision, he recognized the species *D. noerneri* Railliet et Henry 1907 as synonym of the species *D. hadweni* Chapin 1925, and identified the species *D. eckerti* Skrjabin 1931 with the species *D. hadweni* Chapin 1925.

Skrjabin divided the genus *Dictyocaulus* into two subgenera: *D.* (*Dictyocaulus*) and *D.* (*Micrurocaulus*) taking into account the following criteria:

1) Those *Nematoda* are classified as belonging to the subgenus *Dictyocaulus* in which the medio-lateral and postero-lateral ribs of the bursa copulatrix are joined at their base and then separate more or less far off the base.

2) The *Nematoda* in which the medio-lateral and postero-lateral ribs are joined in their entire length, belong to the subgenus *Micrurocaulus*.

Dickmans 1936 has carried out further reduction within the genus classifying the species *D. hadweni* Chapin 1925, *D. eckerti* Skrjabin

1931, and *D. khawi* Hsü 1932 as synonyms of *D. viviparus* (Bloch 1782) while *D. unequalis* Bhalerao 1932 was classified by him as one of the synonyms of the species *D. filaria* (Rudolphi 1809).

This was not yet the end, however, and Dougherty 1946 once more critically revised the species of the genus *Dictyocaulus* which resulted in his classifying the species *D. sibiricus* (Orlov 1934) as one of the synonyms of the species *D. filaria* (Rud. 1809), and the species *D. bisonis* Koffman 1942, and *D. noerneri* Railliet et Henry 1907 as the synonyms of the species *D. viviparus* (Bloch 1782).

Thus, only four species remained in the genus *Dictyocaulus* as a result of the revision undertaken by Dougherty: *D. filaria, D. arnfieldi, D. viviparus* and *D. magnus* (= *Bronchonema magna* Mönnig 1932). Dougherty has considered as not justified the division of the genus into the subgenera carried out by Skrjabin.

At present, there are two opinions concerning the belonging of species to the genus *Dictyocaulus:*

1) That presented by Dickmans 1936 and continued by Dougherty 1946 (related above).

2) That of Boyev 1952 who has backed up the subdivision of the genus *Dictyocaulus* into the subgenera *D.* (*Dictyocaulus*) and *D.* (*Micrurocaulus*) carried out by Skrjabin 1934, and who recognized as correct the following species: *D.* (*D.*) *filaria, D.* (*D.*) *arnfieldi, D.* (*M.*) *viviparus, D.* (*M.*)*cameli, D.* (*M.*) *eckerti, D.* (*M.*) *khawi.*

The latest study on the morphology and taxonomy of the genus *Dictyocaulus* representatives is that by Sarwar 1957. This author not only deals with the problem of the species described belonging to the genus *Dictyocaulus,* but also with the situation of the genus as such. He thus creates his own taxonomic composition. So, he singles out a new genus *Arnfieldia* Sarwar 1957 with the species *A. arnfieldi* (= *Dictyocaulus arnfieldi*) leaving within the subgenus *Dictyocaulus* two species, namely: *D. filaria* and *D. magnus* while he raises to the position of genus the subgenus *Micrurocaulus* with the species *viviparus, cameli* and *eckerti.*

The aim of the present work is to analyse the application, in morphological examinations, of the taxonomic criteria which are now in use in studies on the genus *Dictyocaulus,* and to make a critical review of the species belonging to this genus.

Material and methods

Parasites, mainly collected during lung dissections (41000 specimens) of cattle slaughtered in the abattoir, were utilized for the examinations.

The material was collected during all seasons and from cattle of different age (calves, heifers, adult animals).

The intensity of invasion varied considerably in the animal dissected ranging from only nematode, or a few specimens, to hundreds of worms tangled like a clew or, on the contrary, stretched out in the lumen of the trachea, closely sticking to each other.

Parasites collected from the lungs of domestic cattle presented the fundamental material for the present author's morphological study on the nematodes *Dictyocaulus* Railliet et Henry 1907. However parasites collected from the lungs of *Cervus elaphus* L., *Capreolus capreolus* L., *Camelus bactrianus* L. and *Rangifer tarandus* L. were included in order to obtain comparative analyses. There were 7, 8 and 3 dissections of the red deer, the roedeer and the camel, respectively. The material from the reindeer and the camel originated from the collections of the Soviet Helminthologic Expeditions*.

The material collected was fixed in 75 per cent., alcohol with 5 per cent. glycerol added. The fixing of living nematodes belonging to the genus *Dictyocaulus* has been very difficult and has been not always a complete success. For, the cuticle of the nematode was very fine and often used to break even on these occasions when it was getting in touch with the physiological solution, utilized to wash the tracheal mucus off the worms. The best results in washing off the mucus and in alcohol-fixing were obtained with the worms already dead.

Consequently, the lungs with the nematodes were kept in the refrigerator over night on most occasions. Usually, a period of 24 hours was sufficient for the worms to die off completely.

Results of examinations

In defining the material, the classical taxonomic criteria were applied as usually in defining nematodes of the genus *Dictyocaulus* Railliet et Henry 1907. Those criteria were, first of all: the parasite's host, length and width of body, length and width of pharynx, shape and dimensions of the mouth pouch; in the males: shape of the bursa copulatrix and formation of its ribs, shape and dimensions of the copulation spiculae and those of the additory organ; in the female: disposition of the genital opening and dimensions of the eggs. Besides, many other characteristic features were taken into account: the presence of the circumoral papillae, the situation of the genital and excretory openings, etc.

The results of the taxonometric measurings applied in defining the nematodes are given in two tables containing six columns each. Table No. I contains the data concerning the males, while the other represents the female measuring results. The parasites that were subject to measurings were collected from the lungs of cattle, red deer, roe-deer, reindeer, camel.

The Enigk's 1933 results of the measurings of the *D. viviparus* collected from the lungs of domestic cattle and camels are given for comparison in the last column.

The specific features of the nematodes collected from the cattle lungs showed the widest range of variations in regard to the dimensions. The dimensions of the characteristic features considered as taxonomic in the

* The present author wishes to express his sincere gratitude to the VIGIS Management for the kind placing of these materials at this disposal. Especially thanks be given to Prof. Dr. A. M. Petrov, Director of the Collection.

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Measurements of

	L.viviparus from cattle		L.eckerti from Cervus	
	Skrjabin 1954	Świetli-kowski	Ruchladev 1939	Świetli-kowski
M a l e s:				
Body length	17.34-43.4	27.3-65.4	43.25	22.7-39.4
Breadth in the middle part of the body	0.37-0.66	0.366-0.733	0.458	0.319-0.421
Breadth of the body in the end of the pharynx region	0.32-0.37	0.211-0.372	0.221	0.217-0.319
Length of the pharynx	0.72-1.1	0.918-1.418	0.711	0.831-1.272
Breadth of the pharynx hind part	0.16-0.18	0.119-0.180	0.111	0.111-0.174
Breadth of the mouth opening		0.021-0.037	0.033	0.022-0.028
Breadth of the oral pouch		0.030-0.039	0.039	0.018-0.037
Depth of the oral pouch		0.022-0.035	0.156	0.010-0.018
Breadth of the body in the cloacal region	0.15-0.18	0.131-0.188	0.379	0.157-0.165
Length of the dorsal rip of the copulatory pouch		0.153-0.180	0.158-0.189	0.162-0.198
Spiculae - length	0.224-0.272	0.254-0.329	0.190-0.284	0.198-0.267
Spiculae - breadth	0.048	0.021-0.037	0.032-0.024	0.024-0.034
Gubarnaculum - length	0.064-0.080	0.051-0.081	0.070	0.060-0.061
Gubernaculum - breadth		0.018-0.020	0.031	0.018-0.023
F e m a l e s:				
Body length	23.0-57.5	33.2-74.2	42.36-65.22	26.32-68.21
Maximal body breadth	0.384-0.592	0.291-0.678	03392-06636	0.440-0.530
Breadth in the pharyn geal region		0.234-0.392	0.2054	0.291-0.327
Length of the pharynx	0.8-1.328	1.082-1.403	0.758-1.620	0.994-1.223
Breadth of the pharynx	0.13-0.21	0.129-0.198	0.158-0.205	0.127-0.197
Breadth of the mouth opening		0.033-0.036	0.023	0.027-0.035
Breadth of the oral pouch		0.0338-0.484	0.031-0.063	
Depth of the oral pouch		0.010-0.031	0.016	
Anus - hind end of the body space		0.328-0.484	0.284-0.316	0.283-0.342
Genital opening - fore end of the body space		0.353-0.728		0.423-0.633
Tail glands - end of the body space		0.016-0.022		0.016-0.029
Eggs - length	0.085	0.067-0.097	0.095	0.067-0.086
Eggs - breadth	0.041	0.043-0.054	0.047	0.039-0.052

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Dictyocaulus sp.sp.

D.eckerti from Capreolus		D.eckerti from Rangifer		D.cameli from Camelus		D.viviparus from Camelus	D.viviparus from cattle
Ruchladev 1939	Świetlikowski	Skrjabin 1931	Świetlikowski	Boyev 1957	Świetlikowski	Enigk 1933	Enigk 1933
28.44	19.3-36.5	32.0	29.04-37.5	21.21-58.24	23.84-42.12	44-53	40-45
0.411	0.360-0.502	0.8	0.436-0.608	0.291-0.739	0.329-0.412		
0.332	0.196-0.358		0.304-0.385	0.179-0.448	0.293-0.366		
1.027	0.937-1.367	1.4	0.983-1.284	0.873-1.478	1.265-1.431	1.1-1.3	0.9-1.2
0.142	0.135-0.256	0.2	0.173-0.220	0.105-0.257	0.184-0.237		
	0.025-0.032		0.029-0.036		0.032-0.039		
	0.026-0.035		0.030-0.040		0.033-0.036		
	0.011-0.014		0.019-0.026		0.011-0.014		
	0.121-0.165		0.169-0.188		0.173-0.188		
	0.144-0.193		0.198-0.206	0.147-0.169		0.130-0.150	0.110-0.130
0.226-0.234	0.221-0.294	0.29-0.31	0.273-0.301	0.262-0.349	0.289-0.305	0.250-0.290	0.200-0.230
0.023	0.026-0.030	0.05	0.020-0.024	0.032-0.046	0.031-0.034		
0.039	0.040-0.055	0.06	0.049-0.059	0.059-0.082	0.062-0.069		
	0.019-0.022		0.014-0.024	0.013-0.027	0.019-0.021		
41.0-67.5	32.0-57.4	50.0-60.0	57.7-64.1	37.02-70.89	53.1-64.0	58-75	50-65
0.553-0.674	0.314-0.484	1.2	0.385-0.699	0.448-0.761	0.367-0.431		
0.284-0.458	0.384-0.381	0.2	0.317-0.513	0.224-0.448	0.212-0.258		
1.122-1.580	1.019-1.318	1.6	1.319-1.202	1.097-1.657	1.247-1.141	1.1-1.3	0.9-1.2
0.111-0.205	0.120-0.1631		0.128-0.134	0.156-0.246	0.138-0.192		
0.031-0.095	0.0284-0.0728		0.022-0.027		0.026-0.035		
	0.038-0.051		0.028-0.034		0.036-0.042		
	0.008-0.0138		0.011-0.018		0.012-0.015		
0.351-0.458	0.293-0.442		0.396-0.473	0.313-0.515	0.298-0.389	0.395-0.415	0.360-0.380
	0.423-0.781	0.315			0.237-0.257	0.430-0.500	0.430-0.475
	0.015-0.018		0.018-0.019		0.015-0.017	0.160-0.220	0.120-0.150
	0.070-0.085	0.085	0.072-0.096	0.089-0.092	0.070-0.092		
	0.036-0.041	0.040	0.041-0.054	0.046-0.067	0.040-0.048		

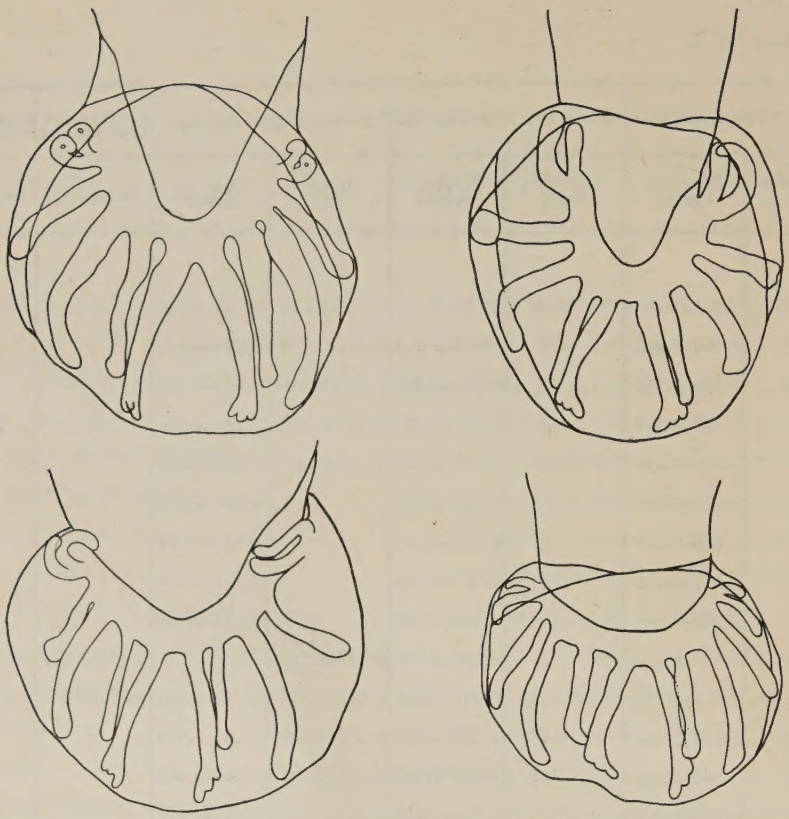

Fig. 1. The variability of the tail end of *Dictyocaulus viviparus* males

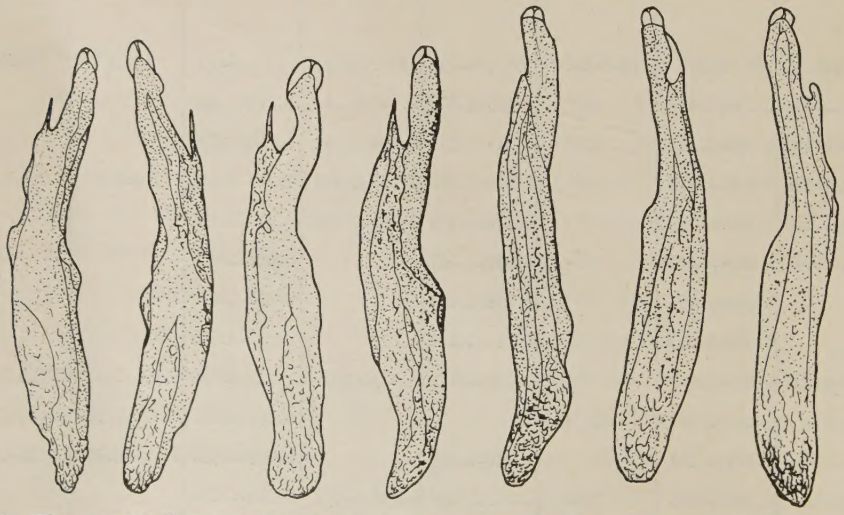

Fig. 2. The variability of the shape of spiculae of *Dictyocaulus viviparus* males

nematodes collected from the lungs of the reindeers, roe-deers, camels, red deers measured by the present author were within the variability limits of the characteristic feature measurings of the nematodes collected from cattle.

Besides measuring the nematodes collected from the lungs of the hosts mentioned also the structure of the bursa copulatrix and that of the genital spiculae in the males were studied. Taxonomically, these elements have been regarded as most typical being considered as the most stable ones. The accompanying drawings of the bursa copulatrix and the copulation spiculae (as well as their dimensions) show the range of shape and measurement variability to be much wider as hitherto admitted. This variability is well illustrated by the representation of the distal end of the copulation spiculae in Fig. 2. The bursa copulatrix variability observed is particularly well reflected by the structure of the dorsal ribs (Fig. 1) and by the shape of the whole bursa as well.

Discussion

Generally speaking, the findings of the present author are in accordance with the observations of Dougherty 1946. The present author, however, can not conclude on the genus *Bronchonema* Mönnig 1932 and the species *B. magnum* Mönnig 1932 from the lungs of the antelope *Damaliscus albifrons* as the parasite is unknown to the writer.

The genus *Dictyocaulus* revision proposed by Sarwar 1957 is interesting. Yet, to the present author's opinion, it cannot be fully accepted. The separation of the species *Dictyocaulus arnfieldi* Cobbold 1884 to form a new genus *Arnfieldia* Sarwar 1957 on the ground of the dorsal rib shape and on that of the structure of the first-stage larva does not seem justified. To the present writer's mind, the dorsal rib structure of *D. arnfieldi* is typical of the genus *Dictyocaulus* and ends in the normal trigitated terminal. The *D. arnfieldi* larva has also a transparent caudal end similarly to other representatives of the genus *Dictyocaulus*.

Species *D. cameli* from the lungs of the camel, described by Boyev 1951*, seems not sufficiently substantiated and the characteristic features distinguishing this species, as given by Boyev, fall within the limits of variability of characteristic features of *D. viviparus* from lungs. Consequently, species *D. cameli* Boyev 1951 ought to be considered synonymous with species *Dictyocaulus viviparus* Bloch 1782.

The drawing of the copulation spiculae of *D. viviparus* published by Skrjabin 1934 does not represent a typical illustration of this worm's copulation spiculae while the drawing of Skrjabin 1931 published as an illustration of the copulation spiculae of *Dictyocaulus eckerti* depicts, to the present writer's mind, typical spiculae of *Dictyocaulus viviparus* collected from cattle.

* The 1951 description of species *D. cameli* by Boyev is unknown to the present author. The description is known only from a type-written copy of the thesis, which however has been dated 1952: Legočnye nematody i nematodozy žvačnych Kazachstana.

Studies on the systematics and taxonomy of the genus *Dictyocaulus* Railliet et Henry 1907 cannot be based mainly on the morphological examinations of the adult specimens, as the case was till now; the data on these worms biology are necessary too, to serve as foundation to such studies, and particularly so the data on the worms biological adaptation to the hosts. In this respect the experiments carried out by Lubimov 1950 and by Šumilina 1950 present much interest. Those experiments showed that the camels and cattle can infect each other with the lung parasites.

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STRESZCZENIE

Autor opracował morfologicznie nicienie należące do rodzaju *Dictyocaulus* Railliet et Henry 1907, zebrane z płuc bydła, jeleni, saren, wielbłądów i reniferów. Badania te doprowadziły go do wniosków, że:

1. *Dictyocaulus cameli* Bojev 1951 (1952) jest synonimem gatunku *Dictyocaulus viviparus* Bloch 1782,

2. Wyniki badań nad przedstawicielami rodzaju *Dictyocaulus* są na ogół zgodne z wynikami Dougherty 1946 (autor nie wypowiada się co do gatunku *D. magnus* (Mönnig) z powodu braku materiału),

3. Prace nad systematyką nicieni należących do rodzaju *Dictyocaulus* wymagają stałego uzpełniania badaniami biologicznymi.